PUBLIC-PRIVATE PARTNERSHIPS FOR RESEARCH AND INNOVATION: AN EVALUATION OF THE AUSTRIAN EXPERIENCE

OECD

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

FOREWORD

A major conclusion of the OECD Growth Study was that governments need to be more responsive to the rapid transformation of innovation processes and related business needs and strategies, and that greater use of public-private partnerships can increase this responsiveness and enhance the efficiency and cost-effectiveness of technology and innovation policy.

In the framework of its follow-up work on *micro-policies for productivity and growth*, the OECD is conducting peer reviews of member countries' public-private partnership (PP/P) programmes for research and innovation. This report examines and assesses PP/P initiatives in Austria, with a special focus on the Competence Centre programmes (Kplus and Kind/Knet).

It has been prepared by the OECD Secretariat,[1] in co-operation with the Austrian Ministry of Transport, Innovation and Technology, and in consultation with other stakeholders in the Competence Centre programmes. It takes into account the results of a peer review meeting which took place in December 2003 within the OECD Working Party on Technology and Innovation Policy.

It is published on the responsibility of the Secretary-General of the OECD.

1. The OECD project team was led by Jean Guinet, assisted by Byung-Seon Jeong. Gernot Hutschenreiter assembled and processed most of the information presented in this report.

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EXECUTIVE SUMMARY

In a long-term perspective, Austria's economic development has been highly successful. However, since the mid-1990s Austria's macro-economic performance has weakened, especially relative to that of several other small economies in Europe. The Austrian economy and innovation system is characterized by the following features, among others:

- Capital formation biased towards physical capital, with comparatively low investment in knowledge.
- Relatively low, but steadily increasing investment in R&D.
- Industrial specialization in areas of medium technology, with an emphasis on incremental innovation.
- Weak industry-science relationships (ISRs) due to both supply and demand side factors.
- A fragmented science base, characterized by small research units often lacking "critical mass."

A major task of Austria's science, innovation and technology policy is to support a new, more R&D-intensive, growth strategy. This is particularly important in order to capture new opportunities in areas of scientific, technological and economic activity promising high social returns such as ICTs and the life sciences. The transition to a new growth path requires investment in knowledge but also brings to the foreground the issue of the overall efficiency of the National Innovation System (NIS). The improvement of ISRs is the single most important means for increasing such efficiency.

In recent years, the Austrian government has taken a variety of policy initiatives to increase both the R&D intensity of the economy and the efficiency of the NIS, including measures to stimulate R&D in the business enterprise sector (e.g., a substantial extension of fiscal support). But fostering linkages in the national innovation system has become the major policy focus, and public-private partnerships (PP/Ps) the major policy instrument.

The Kplus programme of the Ministry of Transport, Innovation and Technology, and the Kind/Knet programme of the Ministry of Economics and Labour are emblematic examples of this reorientation of Austria's technology and innovation policy. Launched in the late 1990s, and funded with fresh money, they encourage and organise the collaboration between enterprises and research institutions (universities, government research labs, etc.) in pre-competitive research with a high potential for commercial application.

While Kplus emphasizes strategic co-operative R&D at a high, internationally competitive level, the Kind/Knet programme is more industry-driven. Although just a few years old there is evidence that both programmes are already successful in promoting R&D co-operation between business firms and research institutions in areas of strategic importance for the Austrian economy and society. They met with positive response from academia and industry resulting in a considerable number of centres. At present, there are 18 Kplus centres and 17 Kind/Knet centres or networks in operation.

In addition, the competence centre programmes already had an important positive impact on the way science and technology programmes are designed and managed in Austria. Kplus, for example, has pioneered the use of evaluations at all levels of programme design and implementation, and of competitive procedures in the selection of proposals. It has, from its very beginnings, explicitly drawn on international good practice and has, over time, itself become a "hub of learning".

The programmes are now at a crossroads, pending important government decisions regarding their long-term future, notably as concerns public financing and the overall governance structure.

This report identifies several issues that draw from international experience and should be carefully considered when making such decisions. They concern the self-sustainability and the portfolio of competence centres, the programme-level governance structure, and the co-ordination of the two programmes with other policy initiatives, including at the Lander or European level.

- *Self-sustainability or continuing government funding?* Decisions on the future of existing centres need to be taken soon in order to reduce uncertainty for the actors involved. There are several options in discussion. Any option taken has to meet certain basic requirements. First, it has to be designed to maintain the demand from and commitment of industry. Second, it should preserve the contribution that the K programmes make to the efficiency of the overall system of funding R&D in Austria, by adding to its flexibility. Third, it should question the "one-fits-all" approach to financing and consider providing different levels of government support to different types of centres, depending on the "market proximity" of their research. Fourth, it should ensure that the portfolio of centres will be managed in a way which gives due consideration to the need to scale up promising centres and to emphasize more multidisciplinary research when consolidating existing centres or creating new ones.

- *Governance.* The present system of PP/P programmes – including Kplus and Kind/Knet and, with a different purpose, the Christian Doppler Laboratories – is overly complex, with resulting overlaps and wastage of resources. Whereas both the science-driven approach taken by Kplus and the more industry-driven approach of Kind/Knet have their merits, there is no compelling need to run these programmes separately. At least there is ample room for improving co-ordination between the two.

- *Complementarity with other S&T programmes.* Whereas their success owes to the favorable framework conditions for research and innovation created by other measures and institutions, including the R&D tax allowance and project-based support to R&D, the K programmes perform a unique and vital role within Austrian innovation. Christian Doppler Laboratories is a complementary initiative to foster smaller scale industry-science co-operation. In various cases they provide a nucleus for more demanding larger-scale competence centres. The K programmes have improved the capabilities of Austrian actors to enter European S&T programmes (by stimulating longer term, larger scale, professionally managed multi-actor R&D), and have strengthened the innovation capabilities of many Austrian regions. However, their interfaces with European programmes and regional innovation policy, especially cluster policy initiatives, should be further improved.

THE ROLE OF PUBLIC-PRIVATE PARTNERSHIPS IN THE AUSTRIAN INNOVATION POLICY

Introduction

Taking a long-term perspective, Austria's economic development has been highly successful. Based on this experience, "Austria has established a reputation as a well performing economy within the OECD. Living standards, as measured by GDP per capita, are in the upper quintile amongst European countries. In the same vein, unemployment has been consistently at the lower end within both the EU and the OECD" (OECD Economic Survey of Austria 2003). Over the period 1990-2002, growth of GDP per capita (2.3% per annum) has been above the EU average (2.0%), while labour productivity growth remained high, in particular in the manufacturing sector (4.2% per annum). Unemployment is still comparatively low, but has gone up considerably. Figure 1 puts Austria's growth performance in the overall EU and OECD context.

In recent years Austria's economic growth has not just lost momentum but has also fallen behind that of fast-growing smaller European economies that have been investing heavily and persistently in drivers of growth. While in the 1980s Austria's growth in GDP per capita was in line with that of other small high-income European countries, it has performed less favorably since the second half of the 1990s. This does not just hold true for per-capita GDP growth but can be demonstrated also with a broader set of macro-economic performance indicators (Aiginger, 2002).

In the past, Austria has relied to a significant extent on technology imports complemented by own "absorptive capacities". This is still reflected in the pattern of capital formation. One characteristic feature of the Austrian economy has been a comparatively high share of gross fixed investment in GDP. In contrast, Austria occupies just rank 11 amongst 17 OECD countries (2000) in terms of "investment in knowledge", including expenditures for R&D, software and expenditures on higher education, though moving towards the EU or OECD average. In addition, investment in ICT is comparatively low. The share of ICT investment in aggregate non-residential fixed capital formation (2001) is the second lowest among 17 OECD member countries. In summary, capital formation in Austria is still biased towards "bricks and mortar".

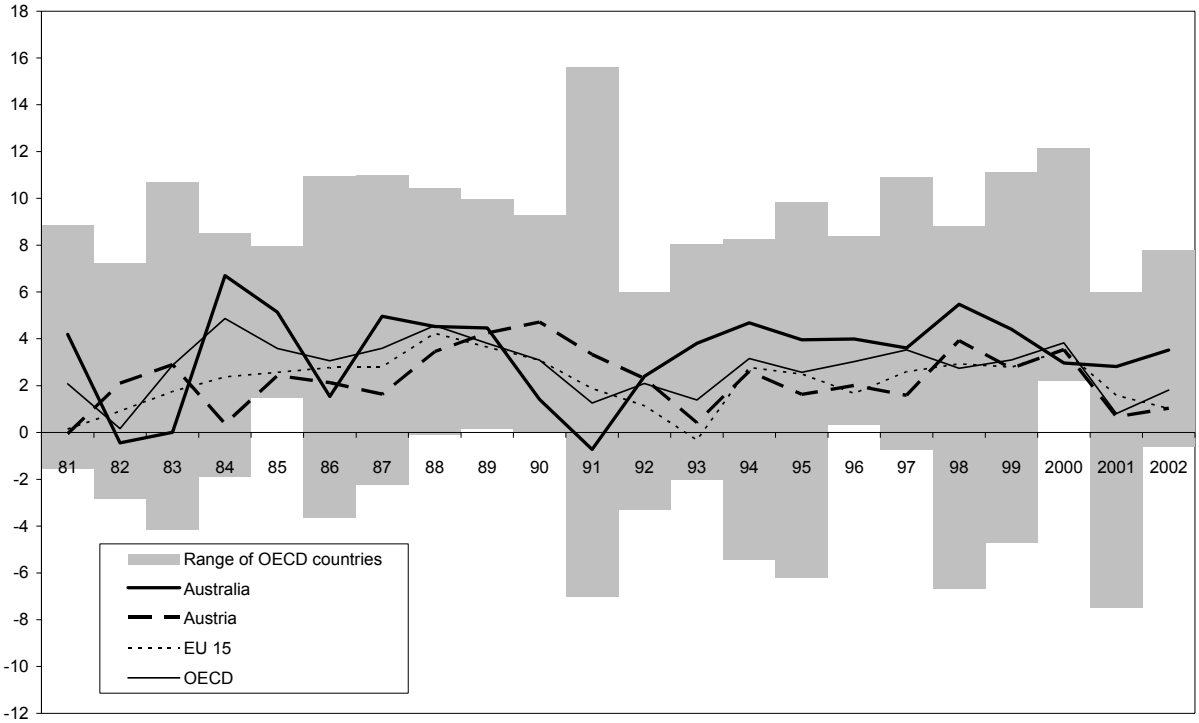
In order to capture new growth opportunities, Austria is in need of a new development model fully recognizing the increased role of science-based innovation. In Austria, framework conditions and incentive structures need to be changed so as to induce a shift from physical capital to investment in knowledge. Sufficient returns on investment in knowledge are among the key incentives for such a shift to occur and be sustained. This requires increasing the efficiency the national innovation system (NIS), particularly through more intensive collaboration between the different actors.

The Austrian innovation system – performance and bottlenecks

Austria has succeeded in raising its GERD/GDP ratio to the EU average, but still lags behind other small European countries with high income per capita. To a considerable degree, Austria's comparatively low investment in R&D is a reflection of its industrial specialization, in particular of the low

share of high-tech industries. The structure of Austria's production and exports is dominated by traditional, low-tech or medium-tech industries or products and structural change is relatively slow (Peneder, 2003; Hutschenreiter and Peneder, 1997).

Figure 1. Annual growth rates of GDP



Source: OECD.

Austrian innovation performance tends to be better (with a comparatively high share of innovative enterprises), but the focus is predominantly on incremental innovation along established technological trajectories close to the traditional areas of competence of firms. This gives rise to specific strengths. There is a significant number of firms, many of them SMEs, operating in market niches where they enjoy strong competitive positions. However, only a relatively small number of research-intensive firms have the capabilities for "breakthrough" technological innovation.

Industry-science relationships (ISRs) have been identified as one of the major weaknesses of Austria's innovation system. In fact, ISR-related indicators show below-average values in international comparisons (Figure 2). This reflects in part the fact that Austria is specialised in moderately technology-intensive industries characterised by a lower degree of science linkages than high-tech ones. But this is also due to framework conditions that inhibit demand for science by the business sector and incentive structures in academia that do not encourage collaboration with industry. An in-depth study of the behaviour of innovative firms confirmed that there were considerable barriers to co-operation between different types of actors in the business enterprise sector, as well as between those actors and the science system (Schibany, 1998). In addition, mobility of personnel between the business enterprise sector and academia has been low so far.

Figure 2. Profiling the Austrian innovation system

(2001 or latest year available)

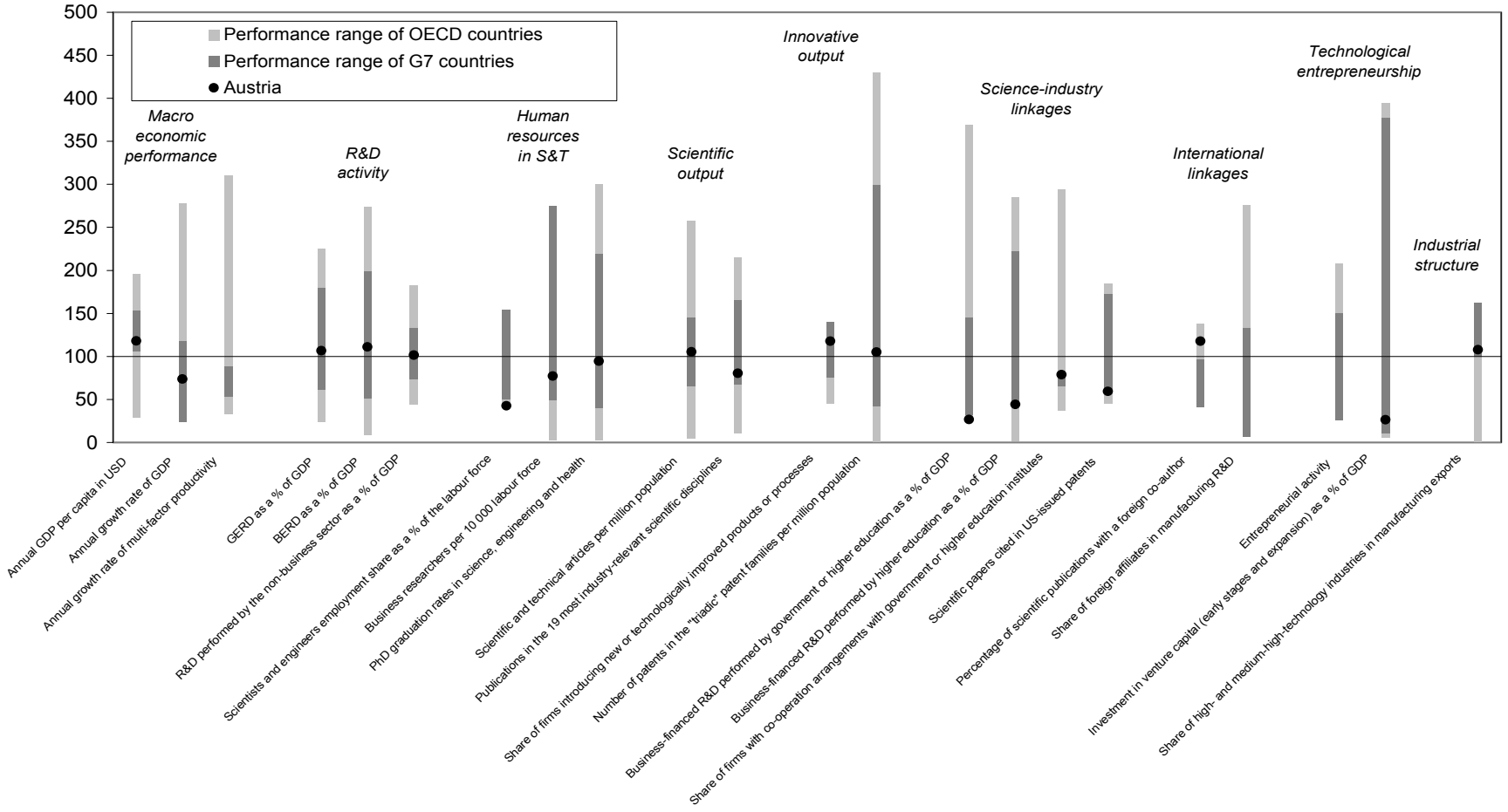


Table 1. Funding of university research (2001)

	€ million	%
Government lump sum funding (1st flow)	791.2	88.0
FWF Research Foundation (2nd flow)	75.1	8.3
Contract research (3rd flow)	33.3	3.7
Total	899.6	100.0

Source: BMBWK, Hochschulbericht 2002.
Note: Excluding Universities of Arts and Polytechnic Colleges.

Table 2. Percentage of University research financed by industry

	1993	1994	1996	1998	1999	2000
Austria	2.0			1.8		
EU	5.8	5.8	6.1	6.4	6.5	6.5
OECD average	5.6	5.6	6.4	6.1	6.1	6.3

Source: Main Science and Technology Indicators, 2003-1.

Up to now, the Austrian science system has been characterised by a large share of the universities in public R&D expenditure and a relatively small number and scale of public labs. R&D performed in the university sector is still overwhelmingly financed by block grants (Table 1). Government lump-sum funding accounts for almost 90% of total university funding (as compared to around two-thirds in the Netherlands, for example). Weak interactions between industry and academia are, in particular, reflected in a low share of funding of higher education R&D by the business enterprise sector *via* research contracts. Contract research accounts for less than 4% of university funding (i.e. about six times less than in the Netherlands). More generally, business-financed R&D performed by government or Higher Education as a percentage of GDP is very low by international standards (Table 2).

At first glance, public sector research establishments (PSREs) – including public research laboratories, government research institutes, the Austrian Academy of Sciences and other publicly funded research organisations – appear to differ strongly from higher education with respect to their sources of finance. Austrian PSREs raise about two thirds of their funding via contract research. However, an in-depth study (Polt et al., 2001) has shown that just about 10% of total funding (including both basic funding and revenues from contract research) is derived from the business enterprise sector or from abroad. Thus, in terms of flows of funds industry-PSRE relations are also weak. In addition, mobility of researchers between Higher Education Institutions (HEI) and PSREs, the level of vocational training in HEI, patent applications by HEI and PSER and their royalties were assessed as being rather low (see Table 3 which provides a snapshot of ISRs in Austria at the turn of the millennium).

Over the past decade significant changes have taken place that may have an impact on ISRs in the longer run (Bundesregierung, 2003). First, the science system has improved its performance and has gained in international competitiveness during the 1990s. Second, innovation processes have become more science-based as witnessed by a rapid increase of the "science linkage"[2] over the 1990s. Third, there has been a considerable structural change of R&D expenditures by industries, away from sectors characterised by incremental innovations (which still accounted for about two thirds of business R&D expenditure in 1993) towards those implementing more science-based innovations (Polt et al., 2001). The fact that innovating firms are co-operating

2. Defined as the average number of citations of scientific publications per patent.

increasingly with universities is another indication that the industrial innovation processes have become more science-based over time.[3]

There remains however considerable room for further improvement. Figure 3 provides a stylized representation of the current strengths and weaknesses of the "Austrian model of ISRs."

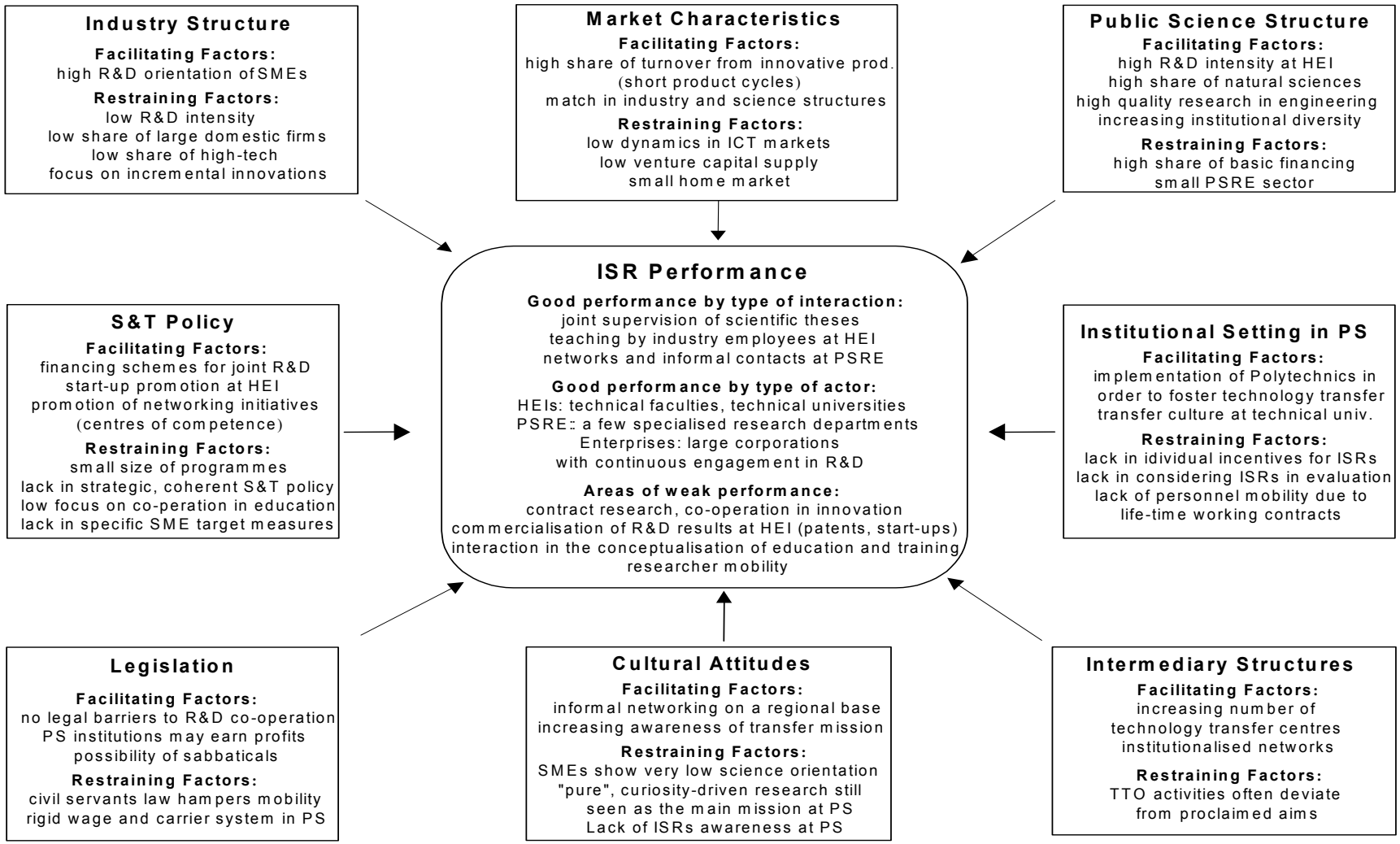
Table 3. Indicators and assessments of ISR in Austria at the end of the 1990s

Type of ISR	*Indicator*	*Value**
Contract and collaborative research	R&D financing by industry for HEIs in % of HERD	2.0
	R&D financing by industry for PSREs in % of GOVERD	2.0
	R&D financing by industry for HEIs/PSREs in % of BERD	1.7
Faculty consulting with industry	Significance of R&D consulting with firms by HEI research	**high**
	Significance of R&D consulting with firms by PSRE research	low
Co-operation in innovation projects	Innovative manufacturing enterprises co-operating with HEIs in %	**12.6**
	Innovative manufacturing enterprises co-operating with PSREs in %	7.1
	Innovative service enterprises co-operating with HEIs in %	5.8
	Innovative service enterprises co-operating with PSREs in %	2.5
Science as an information source for industrial innovation	HEIs used as an information source by innovative manufacturing enterprises in %	4.7
	PSREs used as an information source by innovative manufacturing enterprises in %	1.1
	HEIs used as an information source by innovative service enterprises in %	0.6
	PSREs used as an information source by innovative service enterprises in %	0.7
Mobility of researchers	Share of researchers in HEIs moving to industry p.a. in %	medium
	Share of researchers at PSREs moving to industry p.a. in %	medium
	Share of HE graduates at industry moving to HEIs/PSREs p.a. in %	low
Vocational training	Income from vocational training in HEIs in % of R&D exp.	low
	Number of vocational training participants in HEIs per 1000 R&D employees at HEI	low
Patent applications at science	Patent Applications by HEIs per 1000 employees in NSEM	low
	Patent Applications by PSREs per 1000 employees in NSEM	medium
Royalty income by science	Royalties in % of total R&D expenditures in HEIs	low
	Royalties in % of total R&D expenditures at PSREs	low
Science-based start-ups	Number of technology-based start-ups in HEIs per 1000 R&D personnel	**~ 4**
	Number of technology-based start-ups at PSREs per 1000 R&D personnel	~ 1
Informal contacts and personal networks	Significance of networks between industry and HEIs	medium
	Significance of networks between industry and PSRE	**high**

* Values above the EU average are indicated in **bold** letters
Sources: Polt et al. (2001), based on Eurostat, OECD, and authors' surveys and calculations.

3. According to the latest Community Innovation Survey, about 45% of co-operating firms cited universities or polytechnic colleges as partners in innovation projects. Thus, co-operation with the Higher Education sector is now about as frequent as co-operation with competitors and customers, whereas co-operation with suppliers occurs even more frequently (55%).

Figure 3. The Austrian model of Industry-Science Relationships (ISRs)



Source: Polt et al. (2001).

Policy challenges

A major policy challenge for Austria is the management of the transition to a more knowledge-driven growth path. The Austrian government's goal to boost the GERD/GDP ratio to 2.5% by 2006, as well as by its endorsement of the 3% target (2010) of the EU, testifies of its commitment to foster investment in the new drivers of growth.

However, increasing investment in R&D is necessary but not sufficient for achieving high long-run economic performance. Additional investment in both public and private R&D needs to generate sufficiently high returns. This requires enhancing the overall efficiency of the innovation system. In this respect, there are three priority complementary objectives:

- Encouraging existing firms to engage in more radical types of innovation.
- Promoting technology-based start-ups.
- Increasing the role of the Higher Education sector in providing a research base to be utilised co-operatively with industry and as a breeding ground for start-up companies.

Alleviating the weaknesses identified in industry-science relationships is a prerequisite for achieving these objectives.

Policy responses: the increasing role of public-private partnerships

In this context, PP/Ps for research and innovation came to play an important role. PP/Ps have the potential to increase the flexibility of the system of funding science and technology and its responsiveness to new needs. Well designed PP/Ps can also lead to positive behavioural changes in the innovation system.

In the late 1990s several developments led to the implementation of new policy initiatives based on a PP/P approach. The *Expert Draft for a Technology Policy Concept of the Austrian Federal Government 1996* provided a rationale for these initiatives. In addition, Austria's participation in the EU framework programme increased the readiness to start new multi-firm, multi-actor programmes for research and technological development. Since public support schemes and institutions in place at that time were not sufficiently geared to take up this task, it was perceived as necessary to set up new institutions to manage these new types of programmes.

Project-based, non-targeted support for science, technology and innovation (mainly FWF for basic research and FFF for applied research) had long been dominating the system of public support to R&D. In recent years there has been a move towards programme-based support targeting clearly identified weaknesses in the Austrian innovation system, in particular in the area of ISRs, complemented by regulatory reforms in the public research sector, especially universities.

The Kplus and the Kind/Knet programmes are the most representative examples of this shift in emphasis in Austrian science and technology policy. Launched in the late 1990s, and funded with fresh money, they encourage and organise the collaboration between enterprises and research institutions (universities, government research labs, etc.) in pre-competitive research with a high potential for commercial application. They create centres or networks of competence that may serve several purposes such as increasing the efficiency of the production and distribution of knowledge, creating clusters of competence and critical masses, facilitating technology transfer, fostering linkages with international R&D programmes and networks, and developing human resources.

Table 4. Public-private partnership programmes in Austria

Instrument	Description	Period
Kplus Programme	The Kplus competence centre programme aims to build long-term co-operative research initiatives between public institutions and private companies. K*plus* competence centres are selected in a competitive process according to specific quality criteria and established for a specified time-span (4+3 years).	Since 1998
Kind/Knet Programme	The Kind/Knet programme serves the development and strengthening of internationally competitive technology clusters by supporting competence centres and networks with the purpose to advance, develop and transfer application-oriented technological knowledge, jointly run by business enterprises and universities/public science and research enterprises on a long-term basis (4+3 years).	Since 1999
Christian Doppler Laboratories	Christian Doppler Laboratories (CDL) perform application-oriented basic research on topics of interest to member companies. They provide member firms of the Christian Doppler Research Society with early and direct access to new scientific and technical knowledge. The latter invest on a long-term basis in specific basic research fields and participate in the labs	Since 1989, new form since 1995

Table 5. Budget for public-private partnership programmes (2002)

PP/P programmes	€ million
Kplus	24.0
Kind/Knet	12.0
Christian Doppler Laboratories	4.0
Total PP/P programmes	40.0
Total S&T budget (GBOARD, 2002)	1388.2
Share of PP/P programmes in total S&T budget	2.8%

Christian Doppler Laboratories (CDL) are another example of a recent PP/P programme for enhancing science-industry linkages (Box 1). Unlike Kplus and Kind/Knet, CDL does not create medium to large-scale competence centres but fosters co-operation between business enterprises and small public research teams in a more direct manner. The comparatively low scale of individual CDL and simple procedures make the programme easily accessible. In some cases CDL form a nucleus of future competence centres.

Tables 4 and 5 provide basic information on the two "K programmes" (as Kplus and Kind/Knet are referred to), as well as on CDL. In Austria, these programmes are the only ones which correspond to the (narrow) definition of a PP/P, namely a joint public private effort with a defined goal or target, eventually in a stable institutional setting. This definition excludes programmes which are just providing subsidies to private or public R&D, even if they have a thematic focus.

The University Act passed in 2002 may have considerable impact on ISRs in the long run by affecting the orientation of research, the motivations of researchers and their mobility. The allocation of resources to individual universities will now be based on a performance agreement (over a period of three years) between the Republic of Austria and the respective university. Each university will be granted a fixed annual global budget for the period of the performance agreement. A share of 20% of this global budget will be allocated based on quality- and quantity-related indicators concerning, among others, R&D.

Box 1. The Christian Doppler Research Society and Laboratories

The ***Christian Doppler Research Society*** (CDG) was founded in 1989 to bridge the gap between universities and industry research. Initially located within State run industry, the CDG has transformed itself into a new instrument for the enhancement of industrial competitiveness. In 2002 about 40 industrial enterprises were members of CDG, supporting 26 Christian Doppler Laboratories (CDL). The association is now open to all companies who generate significant value added through research in Austria. Multiple associations of several companies in one CDL are possible. The following combinations are currently approved by the board of directors: Austrian company – Austrian university; Austrian company – foreign University; foreign company – Austrian university. The Management Board is the core decision making body of CDG. It is formed by representatives of member companies, public entities and scientists. The Senate provides the scientific expertise required to guarantee the high quality of research carried out by individual CDL. The International Advisory Council helps to establish and maintain contact with scientists and research institutions world-wide.

Christian Doppler Laboratories (CDL)

By setting up of research laboratories, the Christian Doppler Research Association (CDG) provides its affiliated companies with early and direct access to new scientific and technical knowledge. Christian Doppler Laboratories (CDL) conduct basic research on topics of interest to member companies. At present these areas include primarily:

- Nanotechnology, Materials Sciences and surface Technologies;
- Information- and Communication Technologies;
- Mathematical Modeling and Process Simulation;
- Mechatronics, Measurement Technologies, Process Automation & Control;
- Chemistry and Biotechnnology.

A clear focus on basic research in areas relevant to application helps member companies to attract new and highly qualified employees and alerts Austrian universities to industry's special needs with regard to basic research.

One half of the resources come from private companies interested in particular research projects, 95% of which is directly transferred to the CDL of their interest. The remaining 50% is provided by public sources dedicated to stimulating industrial research in new areas. This mixed mode of financing helps to guarantee a high level of economically relevant output in combination with the freedom necessary in basic research.

As a rule, the individual laboratories are located at universities or other established research institutions; this creates informal and effective communication channels between the member companies and these research units. The annual budget of a laboratory can be as much as € 400.000.

Initiating a CDL is usually a bottom-up process, stimulated either by an industrial partner or a university member or both. Before granting a CDL, an appropriate research plan must be submitted. The life-span of a CDL is, in general, 7 years. The quality and feasibility of the proposed plan will then be reviewed by anonymous, international peer-review. If the project is accepted, an initial research contract is concluded for 2 years. If progress is proved to be satisfactory by means of an intermediate evaluation, the contract will be prolonged for a maximum of 5 more years.

The results of research performed in a CDL will be implemented by the interested member companies through their own R&D Divisions. Thus, close and continuous contact between member companies and the CDL is seen as a prerequisite for success.

CDG has established some 50 laboratories, 34 of which are currently operating. Success of CDG-sponsored research can be measured by two core criteria: the benefit to member companies and the progress made in science. As far as the former criterion is concerned, success has been evidenced by a rising number of companies applying for membership in CDG and their willingness to contribute financially. Progress in science has been shown by an impressive publication record by most of the CDL. More importantly, CDG enjoys high reputation within academia at the national and international level.

EXAMINATION OF THE COMPETENCE CENTRE PROGRAMMES

The Kplus programme

The Kplus programme was developed and started within the former Ministry of Science and Transport, now Ministry of Transport, Innovation and Technology (BMVIT). Based on a policy paper prepared in 1997, programme guidelines were issued in 1998. These guidelines in turn provided the basis of the programme's notification according to EU competition rules. They were complemented by a series of manuals for reviewers, applicants, evaluators, etc.

In designing the Austrian Kplus programme, relevant experience of other countries was taken into due account. This included studying the relevant Canadian, Swedish and Australian programmes, and practices.

The management of Kplus was handed over to the newly established Technologie Impulse Gesellschaft (TIG), a limited company owned by the Republic of Austria represented by BMVIT. TIG received a block grant (capital endowment) of about EUR 50 million of privatisation revenues earmarked for funding the first two calls of the Kplus programme. As institution in charge of the overall management of Kplus, TIG took over the organisation of the selection process, the implementation and monitoring of Kplus centres as well as programme-related information activities.

Kplus is aimed at improving cooperation between scientific institutions and industry in Austria. It funds collaborative research facilities (jointly run by business enterprises and research institutions (universities, government research laboratories etc.) with a specified life time, set up to carry out top-quality, long-term and internationally competitive research and technological development (RTD) projects at a pre-competitive stage. The goal is to perform research that is highly relevant for both the academic world and industry and to develop human capital in areas that are either multi-disciplinary or which are relevant for a number of sectors/companies. The Kplus programme pioneered competitive procedures in the process of selecting projects.

Kplus competence centres are established for a period of four years, with the possibility of extension for another three years, depending on the results of an interim evaluation in the fourth year of operation. Thus the time-horizon is much longer than that of standard R&D projects funded by the traditional schemes of public support in Austria. Characteristics of Kplus competence centres are the following:

- Long-term participation of research institutes and (at least five) companies each to guarantee multi-firm projects and pre-competitive research; on the other hand prevent dependency of centre on one big industrial partner.
- Existence of a scientific core. This is a vital criterion – mere networks do not qualify as Kplus competence centres. This does not preclude that centres have more than one location.
- The annual budget of a centre is typically in the range of EUR 2 to 4.5 million (up to 35% federal funds through TIG, a maximum 25% from other public sources, and a minimum 40%

from industry). A centre typically assembles 30 to 50 researchers working on projects within a structured programme.

The main objective of the programme is to establish long-term co-operative relations between business enterprises and scientific institutions and the pooling of resources to form "critical masses". Given the long-term goals of the programme, the main focus is on building trust and a shared knowledge base.

Box 2. Existing Kplus centres

AB	Competence Centre of Applied Biocatalysis
ABC	Austrian Bioenergy Centre
AC²T	Austrian Centre of Competence for Tribology
ACV	Advanced Computer Vision
alpS	Centre of Natural Hazard Management
BMT	Bio-Molecular Therapeutics
CTR	Carinthian Tech Research
ECHEM	Applied Electrochemistry
FTW	Forschungszentrum Telekommunikation Wien
KNOW	Knowledge Management Center
LCM	Linz Center of Competence in Mechatronics
LKR	Leichtmetall-Kompetenzzentrum Ranshofen
MCL	Materials Center Leoben
PCCL	Polymer Competence Center Leoben
SCCH	Software Competence Center Hagenberg
VIF	Das virtuelle Fahrzeug
VRVis	Zentrum für Virtual Reality und Visualisierung
WOOD	Wood Composites & Chemistry Competence Centre

Currently there are 18 Kplus centres in operation (Box 2), for which EUR 15.4 million have been provided by TIG in 2003. Total cumulated public and private funding of the 18 centres for their initial 4 years amounts to about EUR 230 million. At the end of 2002 there were 1127 employees working in Kplus centres. In terms of full-time equivalents this amounted to a total number of 680, among which 62 key researchers, 445 senior or junior researchers, 54 master's or PhD students and 119 other personnel. About 260 industrial partners of various sizes, 115 university partners, 20 non-university research organisations and 31 other partners are involved.

The Kind/Knet programme

The idea of the Kind/Knet programme dates back to the end of 1997, when the Minister for Economic Affairs announced a plan to foster co-operation between enterprises and science institutions. It has the goal to lay the ground for cluster formation by providing a durable framework for cooperation, and the building of trust and of a shared knowledge base. The programme was launched in May 1999. Selection of the centres/networks and funding began in

the second half of 1999. The Kind/Knet programme is one programme consisting of two lines of action: Kind supporting competence centres and Knet aimed at genuine networks.

- Kind creates industrial competence centres. In most cases they build upon existing networks of enterprises with similar R&D interests. The idea is to concentrate the R&D activities of a number of enterprises and research institutions (universities, government research labs, etc.) working in the same field, with the aim of building up and developing application-oriented technical expertise and then promoting the dissemination of this knowledge in existing and new companies.
- Knet is supporting networks which consist of creating synergies between a number of competence nodes situated in different locations. The prerequisite is that the individual nodes complement one another in terms of their thematic orientation within the framework of an overall concept: existing regional R&D institutions (e.g. university institutes, CD laboratories, polytechnic colleges, joint venture research institutes) are expected to be included as partners.

Box 3. Existing Kind/Knet centres/networks

Mathematical modeling and simulation of processes:

-- IMCC industrial Mathematics Competence Centre

Nanotechnology, material and surface technology:

-- AAR Austrian Aeronautics Research Network for Materials and Engineering

-- Competence Centre for Wood Construction

-- Competence Centre for Wood Technology

-- Competence Network for Wood Research

Chemistry and biotechnology:

-- ACBT Austrian Competence Centre for Biopharmaceutical Technology

-- KMT Competence Centre for Medicine Tyrol

Information and communication technologies:

-- ec3 Electronic Commerce Competence Centre

-- Evolaris Competence Centre for Interactive e-Business

-- HITT Health Information Technologies Tyrol

Mechatronics, measuring techniques, engineering, controlling:

-- ACC Acoustic Competence Centre Graz

-- IKMA Industrial Competence Centre for Mechatronics and Automation

-- KERP Competence Centre for the Recycling of Used Electric and Electronic Devices and Sustainable Product Development

-- Competence Centre for Light Technologies

-- LEC Large Engine Competence Centre for Environment-Friendly Stationary Engines

-- KnetMET Competence Network for Metallurgical and Environment Technology Process Development

-- RENET Renewable Energy Network Austria

The target groups are industrial enterprises with their own R&D department and public research institutions. SMEs without their own R&D can participate as "associate" partners at the level of individual projects. Technology transfer activities are encouraged.

Currently there are 17 centres/networks in operation (Box 3), for which EUR 10.8 million were provided by the Ministry of Economics and Labour in 2003. The Kind competence centres agreements involve 74 industrial partners, 22 university partners and seven non-university research partners as well as five other partners. Knet networks involve 23 industrial partners, five universities, and three non-university public research organisations.

Similarities and differences between the two competence centre programmes

The two programmes were established more or less simultaneously in the late 1990s. Both programmes are examples of PP/Ps for R&D, aimed at enhancing the co-operation between academia and industry and instilling a long-term horizon in joint R&D projects for a fixed period of funding. Both programmes were set up with the implicit or explicit goal to raise R&D expenditure, to remedy risk aversion, speed-up innovation and change "R&D culture" ("behavioural additionality"). They share, among others, the following features:

- They do not "target" specific fields of technology or industries. The definition of the topics takes place through a self-organising, "bottom-up" process.
- They encourage or demand some formal organisational structure or minimum standards. However, participants have considerable freedom to choose the arrangement they consider to be most appropriate to their particular needs. The design of the internal relations within the centres/networks is largely left to the participants. Thus, there is a high degree of flexibility.

At the same time there are differences between the programmes which do not concern their main goals but rather their research emphasis and their implementation procedures. This concerns the degree of formalization of such procedures, the organisation of the selection process, the role of evaluation, the balance of power in internal relations, etc.

- While Kplus centres are primarily knowledge-driven and the programme itself is based on highly structured, formalised processes of decision making, Kind/Knet is predominantly industry-driven and in many respects much less formalised.
- Kind/Knet has the stimulation of private R&D as a major goal, while Kplus puts stronger emphasis on additionality in both the private and public sectors.
- Kplus seeks to promote excellence in research, while the Kind/Knet programme puts more emphasis on the combination of (existing) capacities and technology transfer.
- Kind/Knet includes virtual centres/networks, while the Kplus programme requires that the majority of researchers are assembled at one physical location.
- A major goal of Kind/Knet is the creation and establishment of industrial/technological clusters. In this context Kind/Knet takes regional or local conditions into account. Kind/Knet has therefore a stronger regional dimension than Kplus.

To some extent the creation of two programmes instead of one is also the result of institutional factors. In particular, it is hardly conceivable that there would have been two programmes if competencies in S&T policy were concentrated in one ministry.

The following examines the experience with centres of competence, focusing on the following main issues:

- Role and purpose.
- Participants: How are proposals for centres or networks selected? Do partnerships include small firms and/or foreign companies?
- Financing: How are the centres or networks financed? Are the partnerships contributing to cost-sharing and leveraging of private funds?
- Management: What are the governance arrangements for partnerships? Have specific institutions or centres been established to conduct joint research?
- Intellectual property rights: What are the provisions for intellectual property rights for the results of joint research?
- Evaluation: Are centres regularly subject to evaluation? What are the procedures and criteria? What have been the results?

Role and purpose

The basic assumptions and rationale underlying the two K programmes are rather similar. They were established on similar premises as regards the systemic failures in the Austrian NIS to be corrected.

Whereas the Kind/Knet programme aims mainly at providing a durable framework for building trust among partners in pre-competitive research, the Kplus programme has the more explicit goal to correct the following deficiencies in the Austrian innovation system:

- Low level of science-industry co-operation. Co-operation had so far been of a short-term nature and rather development-oriented instead of strategic and research-oriented.
- Short-term horizon of RTD planning in industry. This fact is rooted in structural features of the Austrian economy (predominance of SMEs, specialization/strengths in traditional industries) and in the predominance of incremental innovation. Many firms lack the capital, human resources and the "spirit for big steps".
- Lack of critical masses. Typical RTD groups both in industry and academia have been small. This resulted in a myriad of research groups, often operating at sub-critical levels in a broad range of fields and with little interaction among each other.

Box 4. Goals of Kplus

A . Building up and utilizing knowledge and competence
  – Sub-objective: performing long-term, strategic RTD
B . Securing/raising the attractiveness of the business location
C . Reaching critical mass
D. Raising the (expert) public's acceptance of RTD
E. Participation in international RTD programmes
F. Increased qualified research efforts in industry (additionality)
G. Implementation and management of research plans; financial performance

The competence programmes have also the role of facilitating linkages between the Austrian innovation system and global and European innovation networks. They inject elements into the system of funding and governing R&D that hardly existed before,[4] whereas for example the EU Framework Programme has for long put an emphasis on multi-actor schemes. Larger-scale programmes, clear criteria for funding and indicator-based governance and research management are rather new concepts in Austrian S&T policy.

Participants

Selection process

The Kplus programme has – from its very beginnings – applied a formalised, competitive process (competitive calls) in the allocation of grants. It pioneered competitive procedures in selecting projects. So far there have been three competitive selection rounds.

As noted above, there is no pre-selection/targeting of specific areas of research or technology. Neither is there any targeting with respect to the type or status of participants. The consortia bidding for grants in the Kplus programme are formed through self-organisation by companies/institutions from business and academia. Thus the process is bottom-up and submitted to strict quality criteria subsumed under the following headings:

- Research programme.
- Work plan, co-operative determination of the research plan.
- Research competence and linkages to science (existing research potential).
- Linkages to the business sector.
- Human resource development.
- Equipment of the centre.
- Internationality.
- Organisation and management.
- Work, cost and financial planning.

The scientific and technological quality is assessed through an independent, international peer review. Peers – up to six per proposal – are selected by the Austrian Science Fund (FWF) drawing on its evaluation experience and access to qualified international peers. The scientific review is complemented by a review of the economic and organisational dimensions. This part is performed by the ERP Fund, an institution engaged in public support for business investment in various areas. Up to now there have been three calls for tender in the Kplus programme. TIG – which is managing several other programmes in addition to Kplus – has made competitive calls its trademark.

In the Kind/Knet programme the decision about the eligibility of a proposal is taken – based on the programme guidelines – by the Ministry of Economics and Labour (BMWA). The review on which this decision is based is performed jointly with a panel of external experts and specialised

4. Exceptions are the so-called "Technologieanwendungsförderung" (Support for Technology Application) in the late 1980s and the programmes of the Innovation and Technology Fund (ITF) in the 1990s.

funding agencies. The Christian Doppler Research Society (CDG) is in charge of assessing the scientific quality of the applications. The Austrian Industrial Research Promotion Fund (FFF) assesses them according to technical and economic criteria. Since FFF is also in charge of the operational implementation of Kind/Knet, the separation of tasks is less clear than in the case of Kplus.

Access of new participants to already existing centres or networks remains to some extent an issue (Polt, 2001). As a major objective of Kplus is to ensure stable and long-term relations between participants, access of new participants is limited but possible (and has been occurring). However, the barriers to entry appear to be relatively high. Access to an already established Kind/Knet centre or network is also possible, but subject to the agreement of the existing network members. Where enlargement takes place, the amount of funding available to the centre/network can be increased.

Participation of SMEs

In the Kplus programme the decisions regarding the participation of SMEs are left to the management of individual centres. Overall, about 25% of the industrial partners are SMEs.

In the Kind/Knet programme the participation of SMEs is not mandatory but applicants are strongly encouraged to include SMEs. In particular the Kind/Knet guidelines quote the special consideration of the technological needs of SMEs among the criteria for granting support to a competence centre.

Participation of foreign companies and public research organisations

Foreign firms can fully take part in a Kplus centre under the following provisions:

- A maximum 25% of the industrial share (i.e. of the minimum 40% private contributions) in the funding of a centre may come from firms that are not based in Austrian. The criterion here is location, while ownership – whether national or foreign – does not matter at all.
- The participation of foreign firms is conditional on benefit for the centre and for Austria.
- There is no direct funding of firms by Kplus. Rather, all Kplus funding – just as all contributions of companies – is destined for the respective centre. There, foreign industrial partners have the same rights as "Austrian" firms.

Foreign partners from the science system may be anything from core partners to loosely co-operating partners. This depends on the structure of the consortium, the requirements for specific knowledge, etc. If foreign academic partners contribute to the centre they are treated like Austrian scientific partners. They may also co-operate *via* PhDs, the exchange of personnel, etc. In centre budgets some funds are earmarked for human resource exchange. There are also some additional incentives for cross-border co-operation. One such incentive is the inclusion of "participation in international RTD programmes" amongst evaluation criteria.

According to the most recent information available out of 285 industrial partners participating in the 18 currently operating Kplus centres 36 (i.e. 13%) were foreign companies. Five centres did not have any foreign industrial partner, whereas the maximum foreign involvement amounted to as much as 1/3 of partners. Apart from having significant international participation, Kplus centres are also highly interregional.

Kind/Knet centres/networks have in general either a dominant regional dimension – the Austrian provinces have a stake in the centres, and some tend to have a regional "core" – or a dominant national scope, e.g. networks with geographically dislocated research facilities. The international dimension is less pronounced. The Kind/Knet programme guidelines state, however, that in order to create international linkages companies located abroad may become partners in a competence centre under the provision that the majority remains in the hands of companies and institutions located in Austria. In practice, a few companies not located in Austria are among the agreement partners in the Kind line of action, whereas there are no such partners to be found at present in Knet.

Financing

In both Kplus and Kind/Knet, public support is provided in the form of grants. In the case of Kplus centres (up to) 35% of total eligible costs are funded through the Kplus programme. Participants bear a minimum of 40% of the costs, the remaining 25% (maximum) are funded from other public sources. The actual structure of funding closely corresponds to the maximum/minimum requirements: The Kplus programme contributes 35%, local government 20%, other public sources (such as universities, research institutes, etc.) 5%, and centre participants from business 40%.

In the Kplus programme, a maximum of 50% of the contributions by partners may be provided in kind. The actual range of in-kind contributions varies between approximately 10% and 50%. In addition to the grants, some assistance is provided in the preparation of proposals as well as in the process of establishing the organisation of centres. Some management advice is provided throughout the duration of the centre.

In the Kind/Knet programme the maximum federal government grant (BMWA) is 40% of eligible cost. The province or provinces where the centre/network is located are expected to provide at least half of the sum granted by the federal government. The share of public funds may also include contributions from universities (also in the form of non-cash contributions). At least 40% of the total eligible costs must be contributed by the private sector. The actual structure of funding by sources differs considerably from the minimum/maximum requirements. Over the period 1999-2003, 33% of funds were contributed by the Ministry of Economics and Labour, 16% by local government, and 51% by industry. This difference is due to the fact that in accordance to EU rules on government aid, the intensity of public support depends on the proximity to market. Contributions in kind are limited to two-thirds of the contributions of centre participants. The funding period is limited to four years, with the possibility of an extension (three years maximum) after a positive evaluation.

Kplus was put on a solid financial basis by endowing its managing institution, TIG, with a capital grant earmarking privatisation revenues. Multi-year funding provided the necessary stability for funding the first two calls. In contrast, the Kind/Knet programme had to face some initial difficulties in securing funds (Polt, 2001). Due to budgetary constraints, the start up of some – already selected – centres/networks had to be put on hold until sufficient funds became available. This might have caused some uncertainties among potential applicants. A stop-and-go policy in funding has proved to be detrimental for programmes where the building of trust is essential.

Table 6. Funding of PP/P programmes (EUR million)

	1999	2000	2001	2002	2003	1999-2003
Kplus						
Total budget	7.99	19.32	28.48	39.93	43.89	139.61
TIG	2.80	6.76	9.97	13.98	15.36	48.87
Other public	2.00	4.83	7.12	9.98	10.97	34.90
Total public	4.80	11.59	17.09	23.96	26.33	83.77
Kind/Knet						
Total budget	4.42	6.10	11.59	24.50	32.96	79.57
BMWA	1.44	1.99	3.78	7.99	10.75	25.95
Other public	0.72	1.00	1.89	3.99	5.37	12.97
Total public	2.16	2.99	5.67	11.98	16.12	39.92
Christian Doppler Labs						
Total budget	4.64	4.14	5.12	7.75	10.62	32.27
BMWA	2.01	1.94	2.35	3.11	3.92	13.33
Other public	0.30	0.14	0.21	0.92	1.83	3.40
Total public	2.31	2.08	2.56	4.03	5.75	16.73

Organisation, governance and management

As regards the organisation of consortia, some basic requirements are set in the Kplus programme. This concerns certain (minimum) requirements, e.g. the number of firms, but also the legal status of centres. After an initial phase of 18 months, during which the partners can organise themselves as associations, they are expected to set up a limited company. As a consequence all competence centres are incorporated (organised as limited companies). On the other hand, TIG does not assume an active role in the "search for partners" but leaves this to the consortium members themselves. The establishment of the relationship is a self-organising process. Centres are largely free to define their internal relations.

A minimum of five industrial participants are required, in order to avoid "single-firm centres" and preferential treatment which might have undesirable effects on competition. This minimum requirement aims also at ensuring critical mass. According to the Kplus guidelines, a centre should have about 20 scientific employees in the initial three years and about 30 (but not less than 20) when fully operative. The results from nine *interim* evaluations show that a size of 30 – 50 people is sufficient for the time being but in the longer term there may be a need to scale-up some centres.

The organisational structure of Kind/Knet centres and networks as well as the choice of their legal form is largely left to the participants. The programme outlines just some minimum requirements. Co-operation may take various forms, ranging from loose "associations" to the establishment of a formal research joint venture as a limited company. In practice, the majority of centres/networks take the form of a limited company. Since the establishment of internal relations is a self-organising process, the centres/networks actually show a great variety of linkages. The Federal Ministry does not take an active role as a partner in the centre/network, but some regional governments do (Polt, 2001).

In the Kind/Knet programme, the annual budget of centres varies from EUR 0.75 million to EUR 5.5 million. Larger centres are not intended at the moment, but the minimum size may be raised to EUR 1.5 or EUR 2 million per annum. More detailed insights into this issue are expected from the current assessment of the two K programmes.

Intellectual property rights (IPRs)

As regards the intellectual property regime, the following distinction serves as best practice in the Kplus programme:

- Basic research. In this case all IPRs belong to the centre and each partner has the right to use the results.
- Industrial research with partner companies. In this case all IPRs belong to the centre and each partner of the project has the right to use the results. The participating company has to define, for each project, an area of interest. Within this area the company is allowed to give sub-licenses to connected companies. Outside the area of interest, the centre is allowed to commercialise the results. Within the area of interest of the partner companies, the centre is permitted to use the results for further research, also with third parties. In case of an industrial property right, it is up to the partners and the centre to decide who will file the patent.

In the Kind/Knet programme there are no standard regulations with respect to IPRs. IPR issues have to be addressed on an *ad hoc* basis, in side letters or articles of association.

Evaluation

An outstanding feature of the Kplus programme is that there is a tight and consistent integration of evaluation and programme development. In addition to the *ex-ante* evaluation of proposals Kplus programme entails the following evaluations of its centres:

- An *ex ante* evaluation.
- An *interim* evaluation. The funding period is limited to a maximum of seven years. After a first term of four years centres are subject to an interim evaluation. If positive there is a second term of another three years. There may be a conditional scientific review already after two years.
- An *ex post* evaluation is performed after seven years.

For the Kind/Knet programme a standardised evaluation scheme was set up two years ago, building on the experience with evaluation of Kplus. In all Kind/Knet evaluations, the Christian Doppler Research Society (CDG) is entrusted with the scientific dimension and FFF of the technical-economic aspects. As mentioned above FFF is also in charge of the operational programme management.

Given the long-term nature of their goals, much of the impact (e.g. the development into fully fledged clusters, commercialization of pre-competitive research projects, etc.) can be expected to be observable only several years after the competence centres or networks have become operative. At present, a joint first assessment of Kplus and Kind/Knet is being performed. The results were made available in January 2004. This assessment is most likely to be followed by a formal evaluation of the Kplus programme.

Box 4. The measurement of additionality in the Kplus programme

The concept of *additionality* in its various dimensions (input, output, behavioral additionality) plays an important role in the Kplus programme at various levels of its implementation. In particular, it is of importance in the following contexts:

- *Ex-ante* evaluation of centres. Evaluators are asked to provide an ex-ante assessment in this regard, covering both scientific-technical and economic aspects.
- Communication between TIG, the agency managing the programme, with Kplus centres. This includes TIG's understanding of its role in negotiation processes (e.g. in defining the research agenda, IPRs etc.).
- *Interim* (4 year) evaluation. Consortia are asked to provide a statement. In addition, a standardized questionnaire is distributed to participating companies at the time of the 4 year evaluation. This questionnaire focuses on quantitative information with an emphasis on input additionality, but also addresses some aspects of output and behavioral additionality. So far 4 centres have completed the questionnaire.
- A future programme evaluation. Measuring additionality is most likely to be a key concern.

Conclusions: major policy lessons and open questions

The Austrian competence centre programmes – the Kplus programme of the Ministry of Transport, Innovation and Technology and the Kind/Knet programme of the Ministry of Economic Affairs – epitomize a shift in S&T policy aimed at accelerating the transition from an engineering-based to a more knowledge-driven path of economic growth. They do so by addressing an acknowledged weakness in the Austrian NIS, i.e. insufficient industry-science relationships.

The two K programmes have the same basic rationale. Both are PP/Ps for R&D, aimed at enhancing the co-operation between academia and industry and instilling a longer term horizon in joint R&D projects. In practice they take two different approaches. While Kplus centres are primarily research-driven and the programme itself characterised by a highly structured process of decision making, Kind/Knet is predominantly industry-driven and in many respects much less formalised. Despite these differences in driving forces and management there is some degree of overlap between the two programmes. While some of the Kind centres might have qualified as Kplus centres, the latter also show a substantial degree of heterogeneity in their orientations and achievements, as shown by the interim evaluations performed so far.

Beyond the pursuit of their immediate goals, the competence centre programmes had considerable impact on science, technology and innovation policy in Austria. Traditionally, public support for R&D predominantly took a project-based, single-firm, bottom-up approach involving no specific targeting. The competence centre programmes – both Kplus and Kind/Knet – also refrained from targeting specific industries or areas of technology but did target specific shortcomings in the Austrian NIS and employed a multi-actor framework. In addition, Kplus introduced competitive calls into the Austrian system of funding R&D and made evaluation an integral part of the programme.

Although the first joint assessment of the two programmes has not yet been completed, there is ample evidence that they succeeded in fostering co-operation between science and industry. Whether or not they are inducing lasting changes in the "research culture" will be a major issue of future evaluations. Although there remains scope for improvement, in particular as regards co-

ordination between the two K schemes, the following aspects in terms of programme design and management can be singled out as elements of good practice.

- *Implementing a sound concept of PP/Ps building on international experience.* There is a well-founded economic rationale for both programmes. They adopt a sound PP/P concept of how to remedy well-identified systemic failures in the Austrian innovation system drawing on international experience. E.g., for the preparation of Kplus, a comprehensive conceptual framework was developed, drawing extensively on international good practices available at the time.
- *Targeting well-defined systemic failures in the NIS instead of specific sectors.* Although neither programme targets specific industries or areas of technology, they are both addressing specific deficiencies in the Austrian NIS.
- *Applying a flexible bottom-up approach.* The bottom-up approach employed by both programmes allows for flexibility and is particularly well-suited to the pursuit of a niche strategy that is appropriate for a small advanced economy.
- *A three-tier governance structure.* Strategy formulation is vested with the respective Ministry in charge, the programme is implemented by a funding agency and the management of centres or networks is entrusted to partners within various institutional arrangements.
- *Quality according to international standards.* There is a strong emphasis on the quality of R&D conducted. This is especially true for Kplus which is designed to support strategic R&D up to international standards, but the quality of research is also stressed by Kind/Knet.
- *Long-term commitment and additionality of funding.* As compared to other forms of public support to R&D the government made a longer term commitment required for building trust. The programmes injected fresh money, i.e. resulted in a substantial increase of funding for R&D in Austria. The extent to which they have induced additional private investment in R&D needs to be assessed more precisely in a formal programme evaluation.
- *Embeddedness in the system of public funding of R&D.* The programmes are well-embedded in the Austrian system of public support for R&D. They are complementary to pre-existing instruments. They are complemented and supported by the Christian Doppler Laboratories (CDL), an effective model of easy-to-handle, smaller scale PP/Ps for R&D between industry and academia.
- *A catalyst of change that sets new standards in evaluation and policy learning.* The programmes bring, in varying degrees, substantial innovations to the Austrian system of public support to R&D. Kplus is a learning hub with respect to the design and management of multi-actor public support programmes. In addition, it sets new standards in making evaluations an integral part of public support to R&D.
- *A diversified portfolio and broad participation.* The programmes gave birth to a diversified portfolio of competence centres/networks covering a wide range of technological areas where there were previously gaps in Austrian capabilities. An unexpectedly high number of actors turned out to be ready to use the new institutional framework to bridge these gaps.
- *Linkages and visibility.* The Kplus programme in particular exhibits a relatively high level of both interregional and international linkages. The programmes have reached a relatively high level of visibility, although over time the individual centres tend to become more visible than the programmes themselves.

Although the K programmes are fairly new they are entering a crucial phase. After several years of practical experience and the first centres approaching the end of their funding period some reflections on accumulated experience and current practices and decisions for the future are called for, regarding the future of both individual centres and the programmes themselves. A first joint assessment of Kplus and Kind/Knet that has been now completed is most likely to be followed by a formal evaluation. In addition, Austria's overall system of funding R&D is under scrutiny and major organisational changes are imminent. Looking ahead, three sets of key questions arise:

- How should the portfolio of competence centres/networks be managed in the long term? In particular, what is the strategy to be adopted toward centres/networks after the (seven years) funding period?
- How to improve synergies and remove overlaps between the Kplus and Kind/Knet programmes? What are the implications of current changes in S&T policy in general?
- What type of fine-tuning should be considered in order to further improve the efficiency of the programmes?

The following table summarises the main elements that should be taken into account in answering these questions.

Table 7. Summary of observations and challenges on the Competence Centre programmes

Efficiency criteria	Observations	Challenge
Appropriateness *Are Kplus and Kind/Knet addressing sound and important objectives which can be related to clearly identified market failures?*	• The competence centres/networks programmes address a major deficiency in the Austrian NIS, weak industry-science relationships. They use appropriate tools. • They constitute a successful combination of "targeting" at specific systemic failures and of "self-organisation" as regards the composition of consortia and their thematic orientation. This approach is particularly well-suited to identify and build on strengths, often in niches. • Kplus and Kind/Knet have the same rationale but they differ in their focus and implementation procedures. While Kplus is more knowledge-driven emphasizing mutual learning and the co-evolution of actors, Kind/Knet is, in general, predominantly industry-driven. Both approaches have their merits. • There is no established mechanism to screen new opportunities and nurture initiatives in areas where potential actors are still dispersed or inexperienced in accessing government support. A pure bottom-up approach does not favour multidisciplinary research areas. • Some centres have a relatively short term research agenda extending very close to market (e.g. Evolaris). • So far the "supply" of high-quality proposals for competence centres / networks has been sufficient. Given the size and structure of the Austrian economy, it may be anticipated, however, that a certain level of saturation will be reached in due time. This may limit the scope for industry-driven centres in the future.	• Focusing / targeting part of the funds to pre-selected areas, at least to encourage more multidisciplinary research on socially highly relevant topics? • Promote further internationalisation to sustain sufficient industry demand for "Austrian science" in the future? • Embed competence centres in broader national and international networks of research in similar or adjacent fields?

Efficiency criteria	Observations	Challenge
Own efficiency *Are Kplus and Kind/Knet cost-effective in achieving their stated objectives?*	• The overall economic efficiency of the K programmes is not readily measured. There are partial measures of their cost-effectiveness and "behavioural additionality". For Kplus a framework to measure additionality has been developed and is available for use. • The sunset clause (four plus three years funding period) contributes to the efficiency. But the majority of centres would not be viable without government financial support in any foreseeable future. Those which could be self-sustained would change their research agenda profoundly. • Given their different purpose, Kplus centres differ from Kind/Knet with respect to their "distance to the market". This raises the issue of appropriate intensities of public support. • There is scope for improved co-ordination of centres and/or centres' activities, including joint projects, information platforms, etc. • Some centres may lack critical mass to become competitive on an international scale. If quality and efficiency standards are to be kept at a high level the rate at which new centres are created is expected to decline.	• Provide different levels of government funding to different types of centres, depending on the "market proximity" of their research? • Shift the emphasis from creating additional centres to consolidation? Scale up promising centres where required? • Strengthen the research interactions among centres? • Promote the sharing of experiences, the diffusion of good management practices, and the development of standardised management tools?
Superiority *Are Kplus and Kind/Knet more effective than other policy instruments which would have the same goals?*	• The K programmes provide unique benefits. They met with high demand both from academia and industry. Their value added in the overall S&T tool-kit has yet to be substantiated by a formal evaluation. • The present system of PP/P programmes – including Kplus and Kind/Knet and, with a different purpose, the Christian Doppler Laboratories – is overly complex. • There is a certain degree of overlap. A few Kind centres may as well be Kplus centres. Both programmes may promote similar types of research (e.g. in the field of mechatronics). The signals sent by the parallel programmes are not entirely consistent. • There are different views with respect to the relative merits of the two programmes. While at least part of industry tends to favour the less formalised approach of Kind/Knet, the specific merits of Kplus are widely recognised. • An innovative way of funding R&D. In order to manage Kplus a specialised institution, Technologie Impulse Gesellschaft Ltd (TIG), was set up. TIG was endowed with a block grant to fund the centers selected in the first calls. This guaranteed stability of funding and thus contributed to building trust.	• What degree of overlap/competition between different public programmes or organisations is acceptable? • How to better co-ordinate the two programmes without loosing their specific comparative advantages? What kind of co-ordination is desirable, considering the whole spectrum of options ranging from loose co-ordination to merger? • Streamline the overall governance structure of PP/Ps?

Efficiency criteria	Observations	Challenge
Systemic efficiency *How do Kplus and Kind/Knet interact with other S&T programmes or instruments?*	• The success of the programmes owes to the favourable framework conditions for research and innovation created by other measures and institutions, including the R&D tax allowance and project-based support to R&D. • The programmes are well embedded in the Austrian system of public support for R&D but at the same time are exerting an impulse for change. • The competence centre approach is not easily reconciled with the requirements of European programmes. • The programmes aim at changing the research and co-operation culture in the Austrian NIS. Other changes in incentive structures, including the new legal framework for universities, may also have a profound impact on the behaviour of actors in the NIS. • The programmes are federal initiatives. Kplus in particular was specifically designed not to be a regional policy instrument. Nevertheless the impact of competence centres on regional innovation systems is important. • Cluster policy initiatives are widely used in Austria, in particular in regional S&T policy. • The programmes are not SME policy tools, but contribute to the promotion of innovation in SMEs by involving many of them in research networks. SMEs without their own R&D can participate in Kind/Knet as "associate" partners at the level of individual projects	• Should the programmes be adapted to create or improve interfaces with European programmes? • Does the new legal framework for universities (University Act 2002) have an impact on the programmes and does it require adaptations? • Improve the co-ordination between federal and regional innovation policy, especially cluster policy initiatives? • Would a participation of the financial sector (venture capital) in the management of the K programmes help increase the participation of SMEs, especially start-ups?
Adaptive efficiency *To what extent have results from evaluation influenced the management of K programmes and centres, how are the centres flexible in responding to growth opportunities or unpredictable change?*	• The monitoring and evaluation of individual centres has been implemented in the way prescribed. There are substantial differences in requirements and procedures between Kplus and Kind/Knet. • Kplus has set new standards in evaluation. • Some Kind centres are heavily dependent on the strategy of one or a few dominant industrial partners (e.g. ACC Acoustic).	• Harmonise monitoring and evaluation standards in the two programmes as far as appropriate? • Develop models of how to organise life after the initial (7 year) funding period, stressing the requirements of critical mass, international linkages, and openness to new participants?

Annex 1. Short description of Kplus centres

Centre	
AB	The researchers of this competence centre study and apply methods from the sophisticated biochemical laboratory of living cells for the industrial manufacture of chemicals which does not damage the environment or deplete resources. Furthermore the relevant enzymes (biocatalysts) are adapted and developed to new conditions and problems. The chemists in synthetics, biochemistry and technology and micro and molecular biologists from Graz and Vienna work together in close cooperation with (international) industrial partners on interdisciplinary problems.
ABC	The Austrian Bio-energy Centre brings together expertise from numerous areas of research such as biomass composting, biomass gasification, process development, chemistry and environmental science. Research is conducted in the field of alternative energy sources. The main emphasis of their work lies in the generation of energy using biomass.
AC²T	The main task of AC²T (Austrian Centre of Competence for Tribology) is largely interdisciplinary research, on a pre-competitive level in the field of materials (surfaces and surface layers) and lubricants with the aim of supporting the partners in the optimisation and development of products with regard to improving their life span, reliability and safety as well as financial and environmental viability.
ACV	ACV is working on technological advancement in digital image processing and pattern recognition. The results gleaned should be put into industrial practice by both the partners involved as well as the centre itself. The scope of potential application ranges from access control systems using biometric sensors through the automotive industry, robotics and industrial inspection to remote reconnaissance and measurement.
alpS	The alpS centre for natural hazard management deals with the sustainable protection of the alpine economic and natural habitat. Together with the authorities, research institutions and partners from the business sector, a research team works on a trans-disciplinary level on current problems when dealing with natural hazards. AlpS researches the hazard potential of natural occurrences particularly from the point of view of global change and global warming and then develops systems, products and services to effectively counter these.
BMT	The main aim is to identify new molecules in this system and then to analyze these molecules for their functional importance in order to develop new methods of diagnosis and treatment for illnesses using such characteristic molecules. Such illnesses can be autoimmune deficiencies, allergies or chronic inflammation including atherosclerosis. The centre stems from an initiative of institutes and clinics in the sphere of the medical faculty of the University of Vienna, large pharmaceutical companies acting in Vienna and various biotech start ups.
CTR	CTR is dedicated to industry-oriented research, development and implementation in the area of smart sensor and actuator systems. To create customer-oriented systems and product solutions and to optimise quality, production and automation, we combine pre-market research and technology development with in-depth expertise at every stage of implementation. By cooperating and networking with research centres and business associates at an international level, we also aim to enhance Carinthia's attractiveness as an industrial location.
ECHEM	ECHEM's main emphasis lies in electrochemical surface treatment (coating, anti-corrosives), energy storage and conversion (new batteries and fuel cells) as well as electrochemical environmental cleanups (for example soil decontamination). The scientific background of the centre is applied electrochemistry with three areas: electrochemical surface treatment and coating technology (ESURF), batteries and fuel cells (BATT) and electrochemical recycling and environmental engineering. The companies and research institutes involved in the centre work together on projects in all these areas. These projects are important for the majority of the partners.
FTW	At the centre of FTW's activities one finds highly current research topics which have established themselves at the forefront of product development and therefore lend themselves to cooperation initiatives even between competing companies. The research programme of FTW is divided into six core themes which are consolidated in the following three areas of application: Core network, wire line access and wireless access.
KNOW	The KNOW Centre is Austria's competence centre for knowledge based applications and systems. The core areas of competence of the centre lie in the fields of information technology for knowledge management as well as human and organisational based knowledge management. As a link pin between science and business the KNOW centre conducts applied research and development projects based on problems and orientated at results. The aim is to transform basic scientific results into innovation for industry.

LCM	The Linz Centre of Competence in Mechatronics is an internationally acknowledged R&D partner for mechatronic problems, an elite training Centre for high-tech enterprises and the nucleus for the technology companies. The targeted implementation of knowledge by means of professional project management and the rapid establishments of an additional non-Kplus sector is the basis for long-term partnerships and the successful achievement of innovatory projects.
LKR	LKR was founded in 1994 as a site of the Austrian Research Centre Seibersdorf (ARCS) in Ranshofen, Austria, and turned into a 100% subsidiary, LKR Ltd., in September 2000. LKR Ltd. runs two profit centres, the Kplus Centre for High Performance Light Metals, and the Non-Kplus Centre in which LKR Ltd. works on research projects with industrial partners on order base or funded European or national projects
MCL	The Materials Centre Leoben (MCL) concentrates its activities on modern materials technology as the basis for innovation in the materials themselves, in their processing as well as in their application. The MCL is specialized in solving complex, multidisciplinary problems. Strategic analyses together with partners from industry form the basis for the targeted development of know-how, methods and infrastructure for the opening up of promising fields such as surface engineering (nano coatings), multipurpose materials and modern tool technology.
PCCL	The objectives of PCCL are to construct and firmly establish long-term cooperative research and development initiatives together with cutting edge companies of the polymer industry and the relevant service institutions (engineering consultants etc.); the development of new improved technology for the manufacture and use of polymers as well as for the generation of new polymer products for important promising areas of technology (construction and mobility, IT, electronics, solar technology, microtechnology, etc.). PCCL aims to support, above all, small and medium sized enterprises in solving scientifically demanding problems in the polymer field. It should contribute to the protection of the environment and the orientation of R&D activities to the requirements of a development which is sustainable. Finally it should build up scientific and technical personnel and ensure a continuum of qualified leading figures.
SCCH	SCCH is an internationally recognized research establishment in the field of software which is orientated to the demands of the market. As one of the largest independent research centres in Austria the SCCH plays a pioneer role in software technology research and development trends. The aim of SCCH is to conduct high level, internationally competitive and pre-competitive research and development which are both scientifically and economically important.
VIF	Modeling and simulation are among the most promising tools of modern engineering science. Together with the objectives for the individual projects, clusters and areas as defined in the research programme the following are at the top of the agenda: the opening of the university for industrially relevant basic research, the improvement in the quality of education, the increase in the attractiveness of this research for young people, the transfer of research into industry as well as the reduction of the time required for product development in industry.
VRVis	The research emphasis of VRVis lies in the development of intelligent three dimensional user interfaces in five closely linked software development fields. It is only the combination of various research disciplines which are normally independent of each other that will enable the solving of complex problems as well as the transformation of this technology into commercially viable forms. Thus the disciplines of virtual reality and visualization work together with computer graphics, intelligence agents, usability engineering and computer vision within the centre VRVis on a trans-disciplinary level in order to promote the development of intelligent three dimensional user interfaces for commercial application.
WOOD	Since the beginning of 2001 the Austrian and even the central European market economy possess a research centre which has available the necessary expertise to develop sustainable industrial solutions based on the renewable raw material wood which is both as traditional as it is promising for the future. WOOD Kplus is dedicated to the fundamental principles of sustainable development and puts these into practice in technical innovations for the future. WOOD Kplus can already boast 80 scientific and technical personnel, who bring in expertise from multifarious fields such as chemistry, the wood industry and technology, enzyme engineering, biotechnology, physics, process engineering and many others. The competence centre WOOD Kplus is the optimal business partner for the development of “engineered wood”, the tailoring of wood for new applications.

Annex 2. Short description of Kind/Knet networks/centres

ACC Acoustic Competence Centre Graz

ACC works in the field of vehicle acoustics, offering application-oriented solutions and suitable methods for industry. These solutions are based on up-to-date research results and its own fundamental research activities. For example, inside noise levels of cars are calculated with the help of verified high-quality simulation models in order to optimise the structures of new vehicles. The methods developed are used for improving vehicle comfort, complying with noise limits, and reducing development times. Moreover, ACC promotes the co-operation of universities and industry, and supports the implementation of research findings *via* transfer of know-how to the industry.

Targets: Improving vehicle acoustics through fundamental research; Promoting the cooperation of universities and industry in the areas of method development and applications; Enhancing the transfer of know-how to the industry.

IKMA - Industrial Competence Centre for Mechatronics and Automation

IKMA supports large, medium and small enterprises of all business sectors in the fields of mechatronics as well as measuring, control and testing technology. In the Industrial Competence Centre, metal-producing and processing companies cooperate with research institutions for the joint development of solutions related to image processing, automation, simulation and testing technology, e.g., the three-dimensional measuring of manufacturing sections for quality assurance or complex process simulators for the development of new high-tensile steels. IKMA is designed to promote the development of business competence and knowledge. In addition, IKMA conducts trial measurements, preliminary tests and studies for enterprises; services are tuned to the specific needs of enterprises.

Targets: Customer-oriented preliminary tests and studies with research character; Developing overall solutions, from theory and development to intra-company implementation; Development, construction, manufacturing and testing of prototypes.

RENET Renewable Energy Network Austria

The RENET competence network examines the possibilities for using biomass for energy generation. In particular, RENET develops knowledge and competences for heat and power cogeneration from biomass. The underlying purpose of the research work is the promotion of renewable forms of energy through research and development and to help achieve the breakthrough of new technologies for the energetic utilisation of biomass and, ultimately, for the realisation of the political objectives. The RENET competence network, an association of operators, scientific institutions, and manufacturers of energy generating plants and environmental technology plants, is designed to enhance knowledge in this field and to develop the necessary know-how for practicable solutions.

Targets: Promoting the energetic utilisation of biomass through research work and development; Development and implementation of new technologies for heat and power cogeneration from biomass; Contributing to the breakthrough of renewable energy with the purpose of achieving political objectives.

Competence Centre for Wood Technology

The Competence Centre for Wood Technology is based at Wood Research Austria. In cross-sector activities, the competence centre develops future-oriented products, processes and technologies for wood as an environmentally friendly raw material, and generates new methods for a comprehensive quality evaluation. Moreover, it promotes the transfer of know-how between research and industry. In seven impulse projects, experts of Wood Research Austria co-operate with partners from the timber industry in the development of innovative solutions for top priority issues, such as longitudinal wooden joints, high-tech profiles for windows and facades, material utilization of old wood, modular construction elements, wood-plastic composites and wood pelleting.

Targets: Promoting the combined use of wood as a raw material; Increasing the competitiveness of wood as a material with different uses; Further development of the R&D services for boosting the innovation in the timber sector.

Evolaris Competence Centre for Interactive e-Business

Evolaris stands for the awareness of customers' Internet needs, using them for economically expedient business models while gaining maximum customer confidence. Evolaris operates in a dense network of internationally leading companies contributing business-specific know-how and concrete implementation experience, as well as globally recognised science partners demonstrating the latest developments in the area of methods and tools. The three Evolaris business units – Wants, Business Models, and Trust – provide solutions for specific questions. The solutions are based on a holistic approach, including the analysis of customer needs, business model evaluation, and legal and technical security.

Targets: Understanding customers' Internet needs, translating them into useful features of products, services and processes; Evaluating the economic expediency of internet activities and the development of innovative business models; Support with legal-technical tasks in the area of security and creation of prerequisites for confidence in the Internet.

EC3 Electronic Commerce Competence Centre

EC3 is a partnership among four university institutes and 10 Austrian companies whose common purpose is to spur R&D as well as knowledge transfer in E-Commerce. The projects with EC3 are executed to stand in a mutual dependency. The research project "Scenarios for x-Commerce" provides the foundation for the other projects. It combines techniques from market research, business development, data mining, experimental economics and simulation in order to deal with the challenging task of analyzing new application scenarios.

ACBT - Austrian Competence Centre for Biopharmaceutical Technology

The research focus of ACBT is on the optimization of manufacturing processes for the production of biopharmaceuticals. The development of such pharmaceuticals is a highly complex and exacting task. Besides, manufacturers are subject to strong competitive pressure. In this situation, it is of crucial importance to reduce development times and distinctly increase the efficiency of development processes in order to set up improved production processes within the minimum possible time, so that biopharmaceutical active substances will be available more quickly for clinical examination and mass production of drugs.

Targets: Optimization of manufacturing processes for biopharmaceuticals; Development of a highly specific methods platform; Clustering of industrial and scientific competence.

AAR - Austrian Aeronautics Research

R&D is carried out on different lightweight materials (e.g. composites, Ti-alloys and MMC's as well as combinations thereof) and processes (curing and pressing, forming, joining, heat treating) for different aircraft components (panels and skins, cryogenic feeding lines, turbine blades and vanes, landing gears, helicopter shafts). The main R&D directions are the modeling and simulation of lightweight materials and structures, the prediction and measurement of fatigue performance, the development and implementation of specific test methods and facilities as well as material evaluation and development. The network approach has been chosen because it optimally conforms to the needs of the Austrian aeronautics supply industry to attain a critical mass both in technical and scientific capacity. The nodes of the network located in five Austrian provinces are a platform for intense co-operation for technological innovation and scientific expertise, and are in a position to involve additional companies.

KERP - Competence Centre for the Recycling of Used Electric and Electronic Devices and Sustainable Product Development

KERP aims at improving the environment-friendliness of electric and electronic products, such as household appliances, mobile phones or computers. For this purpose, the Competence Centre looks at the entire product life cycle - from design and production, consumers' usage behaviour, to the recycling of used appliances - in order to optimally coordinate these phases. Activities concentrate on „eco-design", „focus on human beings" (usage behaviour, education and further training, knowledge transfer) and "end-of-life management" but also on the extension of the period of product use, the reuse of materials and components, as well as eco-efficient logistics. The know-how developed is available primarily to the partners of KERP, industrial enterprises and scientific institutions, but eventually also to other interested enterprises.

Targets: Optimization of ecologic consequences of electric and electronic devices in view of their entire life cycle and of the eco-design; Recycling of electric and electronic products and components, as well as development of technologies and strategies for extending their period of use; Development of eco-efficient logistics.

KnetMET - Competence Network for Metallurgical and Environment Technology Process Development

In the framework of the KnetMET research programme, the working team of VOEST-ALPINE Industrie-anlagenbau GmbH & Co (VAI) (responsible for coordination), voestalpine Stahl GmbH, voestalpine Stahl Donawitz GmbH and VEITSCH-RADEX GmbH develops new metallurgical technologies and the related plant technology. The KnetMET programme focuses on the mathematical and physical modeling and simulation of metallurgical processes including the necessary case-hardened and fireproof materials, aiming at an optimum process management with regard to product quality and minimization of the amount of energy and raw materials used. The knowledge acquired in the network is to contribute to the improvement of manufacturing processes and the development of new marketable products, thus increasing the competitiveness of all partners. KnetMET creates a new R&D infrastructure for metallurgical research.

Targets: Enhancing the development expertise of new metallurgical technologies and related plant technology for the creation of new marketable products; Strengthening the basis of technological knowledge and the competitiveness of all partners via networking and mutual complementing of the participating companies, universities and research societies; Cooperation with highly qualified suppliers from the SME area.

LEC - Large Engines Competence Centre

This competence centre for environmentally friendly stationary engines develops large engines with maximum efficiency and minimum emissions. For the development of novel combustion methods such as engines, the competence of the industrial partners and of Graz Technical University, where LEC is based, is planned to be concentrated and permanently enlarged. This is designed to be LEC's contribution to a technology thrust in the field of energy-saving cogeneration plants (combined heat and power generation). For its R&D activities, LEC will use two large-engine test stands for single cylinder research motors. Partners of the competence centre are AVL List GmbH, Jenbacher AG, OMV AG, and Steirische Ferngas GmbH.

Targets: Development of environment-friendly large engines with maximum efficiency and minimum emissions; Development of future fuels and lubricants for large engines; Concentration of competence available in Austria for the development of large engines.

HITT Health Information Technologies Tyrol

The competence centre HITT focuses its work on the field of medical informatics. Its primary goal is the research and development of IT solutions for the optimization of the public health service and of working processes in hospitals. As a firm part of the Medical Cluster Tyrol, the competence centre sees itself as a platform for innovative companies and projects. The activities of HITT are guided by three aspects: from the technological point of view, HITT improves information and communication via greater data availability, information preparation and data security. From the organisational point of view, the competence centre aims at networking “healthcare professionals” in all areas of healthcare and social security. The comprehensive integration of all employees, and in particular of the patients, into a health network, represents the social aspect of the work.

Targets: Research and development of IT solutions for the healthcare system; Networking of actors in the healthcare system via IT solutions; Integration - in particular of patients - into a health network.

KMT - Competence Centre for Medicine Tyrol

Medical engineering has become indispensable for the diagnosis and therapy of diseases. To meet the future demands with regard to research and development, the Competence Centre for Medicine Tyrol (KMT) clusters and coordinates enterprises and research groups in the Medical Cluster Tyrol. In Innsbruck, an internationally recognised centre of medical research, universities and research institutes cooperate closely with hospitals and health facilities as well as economic and industrial enterprises. The focus is on research and development in the fields of biotechnology and bio-informatics, implant technology, and tissue engineering. KMT sees itself as a platform for all partners, for the synergetic networking of project, development and market activities.

Targets: Strategic and commercial counseling of companies and organisations operating in the environment of KMT; Platform for the alignment and implementation of research results right up to market positioning; National and international networking of knowledge in the Medical Cluster Tyrol.

IMCC - The Industrial Mathematics Competence Centre

IMCC deals with the computer-aided simulation and optimization of economic processes and technical issues on the basis of mathematical modeling. In the last years, computer simulation has increased greatly, above all due to the rapid development of computer capacities and the further development of efficient mathematical simulation and optimization processes. Today, fully three-dimensional simulations, even of complex technical processes, can be implemented with the help of modern algorithms. IMCC aims at combining the industrial mathematical competence of its partner companies from various industrial branches, from plant construction to medical engineering, as well as renowned institutes of three universities.

Targets: Clustering of industrial mathematical competences; Mathematical modeling, simulation and optimization of technical and economic processes; Further development of industrial mathematical methods.

Competence Network for Light Technologies

The primary emphasis is on five areas: 1. Traffic: Tunnels, roads, urban spaces, 2. Daylight: Light guidance, simulation, sun protection for buildings, 3. LED: Light emitting diodes as innovative light sources and their use for lighting purposes, 4. Free-form surfaces: Light point decomposition, calculating methods for reflectors, 5. Technology transfer: Training, further education, interdisciplinary projects. Within the scope of the technology-transfer focal area, the Light Academy is being established with a university course for light design, in close cooperation with Innsbruck University. The Competence Centre for Light Technologies GmbH is the field office of the Competence Network for Light Technologies.

Targets: Currently working on 28 research projects in the three network junctures - Tyrol, Vorarlberg and Vienna; Building a communication platform for the internal exchange of information in the network; Developing service offerings for individual businesses and research consortia.

Competence Centre for Wood Construction

The competence centre has set itself the aim of dealing with scientifically and economically relevant research topics in the area of wood and wood construction, clustering resources and on a long-term basis, enhancing the co-operation between science, research, and construction and timber companies. Joint projects of the timber industry and the competence centre, which is based at Graz Technical University, deal with the study of new products, taking into consideration various species of wood and basic products, as well as wood jointing technology. Further issues are quality assurance for the manufacture of certain wood products, grading and strength, and the processing and implementation of the European wood construction standards for Austria.

Targets: Long-term boosting of wood construction research; Clustering resources of research and industry; Research into new wood construction products.

Appendix 1. List of the persons interviewed during the OECD mission[5]

(29 September – 3 October 2003)

K*plus*

- Mr. Rubert Pichler (BMVIT)
- Mr. Harald Isemann (TIG)
- Mr. Harald Hochreiter (TIG)
- Ms. Dorothea Sturn (TIG)
- Mr. Markus Kommenda (Manager, Kplus Center FTW)
- Mr. Gerhard Nauer (Manager, Kplus Center ECHEM)
- Mr. Georg Stonavski (Manager, Kplus Center VRVis)

K*ind/Knet*

- Mr. Johannes Dobinger (Christian Doppler Research Society)
- Mr. Renald Kern (FFF)
- Mr. Josef Affenzeller (Manager, Kind Center ACC)
- Mr. Otto Petrovic (Manager, Kind Center Evolaris)

Austrian Council for Research and Technology Development

- Mr. Michael Binder
- Ms. Brigitte Tiefenthaler

Experts

- Mr. Fritz Ohler (Technopolis Austria)
- Mr. Wolfgang Polt (Joanneum Research)
- Mr. Andreas Schibany (Joanneum Research)
- Mr. Klaus Zinöcker (Joanneum Research)

Other actors

- Mr. Peter Piffl-Percevic (Office of the Government of Styria)
- Mr. Markus Michaelis (Joanneum Research)
- Mr. Willi Simma (Joanneum Research)
- Mr. Michael Stampfer (Vienna Science and Technology Fund, WWTF)

[5] The OECD review team was composed of Jean Guinet (project leader) and Gernot Hutschenreiter.

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